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It's Everybody's Business:
Submissions to the Science Council's Committee on Sustainable Agriculture

A Discussion Paper

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It's Everybody's Business

Submissions to the Science Council's
Committee on Sustainable Agriculture

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FOREWORD

The agriculture and food industry is a cornerstone of the Canadian economy. Annual sales exceed $50 billion and the sector provides direct and indirect employment for 14 per cent of the country's labour force. In all, agriculture and food production account for as much as one-third of Canada's trade surplus.

Yet the future of agriculture is in jeopardy as a result of serious economic and environmental problems. Global trade wars, high interest rates, and soaring input costs have combined with widespread soil erosion, drought, and pollution from crop and livestock operations to undermine the farm economy and heighten our awareness of the delicate relationship between farmers and their natural resources.

Short-term remedies are not the answer to the complex, chronic, and interrelated problems now faced by our food production system. What is required is a fundamental rethinking of our approach to agriculture and the values on which it is based.

In 1990 the Science Council of Canada launched a major study to investigate how science and technology can best be managed to achieve an agricultural system that is economically and environmentally sustainable. As part of that study, the Council invited written submissions from organizations involved in different aspects of the agri-food system. Twenty-nine briefs were received, representing the views of thousands of individual Canadians. The Agricultural Institute of Canada, for example, submitted a brief based on position papers from 11 member associations with a total membership of over 10 000.

The submissions show that, although the principle of sustainable agriculture is broadly accepted as a long-term goal, opinions are divided on what the term really means and how to achieve it. The following synthesis of the submissions reveals areas where consensus is emerging and pinpoints areas of remaining contention. By making it available, the Science Council hopes to focus debate on the most crucial issues.

The submissions form part of a broad consultation process carried out by the Science Council's study on sustainable agriculture. They have been complemented by personal interviews across the country with farmers, scientists, government officials, environmentalists, consumers, and representatives of the business community. In addition, the Council has conducted three workshops and commissioned 10 expert reports. The final report of the Council's study on sustainable agriculture, which will include policy recommendations, will be published in 1992.

Janet E. Halliwell
Chairman
Science Council of Canada

1. A COMMON UNDERSTANDING

Virtually all the submissions to the Science Council's committee on sustainable agriculture begin with a definition of terms, a marking out of the territory covered by the respondents' concerns.

From Manitoba, the Keystone Agricultural Producers' brief begins at square one with a definition of agriculture: "Agriculture is the production of plants and animals for the benefit of man."

Most of the briefs, however, zero in immediately on the meaning of sustainable agriculture. That so many organizations feel compelled to define the term is not surprising. To quote the brief from the Natural Sciences and Engineering Research Council:

> As far as the scientists and engineers are concerned, the term "sustainable agriculture" did not exist two years ago [1988], and a clear definition only appeared last year [1989].

Both the Crop Protection Institute of Canada and the Canadian Fertilizer Institute choose to invoke as their point of departure the broad notion of sustainable development. This concept came to world attention in 1987 with the release of the report of the Brundtland Commission (The World Commission on Environment and Development), set up by the United Nations.

The 21 members of the Commission warned that humanity's propensity to disrupt natural environmental processes threatens the survival of life on our planet. Their prescription: a new approach to development that recognizes the interdependence of economy and environment as well as the interdependence of the peoples of the world.

Despite the scale and urgency of today's problems, the Brundtland Commission concludes on an optimistic note:

> Humanity has the ability to make development sustainable — to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.

Since the release of the Brundtland report, strong support for the concept of sustainable development has been expressed in Canada by federal, provincial, and territorial governments as well as by the private sector and the general public.

To study the implications of the concept for the agri-food sector, federal and provincial ministers of agriculture set up a committee on sustainable agriculture in 1989. The working definition agreed on by the committee was as follows:

> Sustainable agri-food systems are those that are economically viable, and meet society's need for safe and nutritious food, while conserving or enhancing Canada's natural resources and the quality of the environment for future generations.

This core definition is accepted specifically or in essence in almost all the briefs received by the Council. At the same time, many respondents offer further exposition of one aspect or another of the definition.

"Short-sighted policies are leading to degradation of the agricultural resource base on almost every continent: soil erosion in North America; soil acidification in Europe; deforestation and desertification in Asia, Africa, and Latin America; and waste and pollution of water almost everywhere."[1]

Agri-food systems

Food production is widely assumed to be the main purpose of agriculture, although fibre and fuel production are mentioned in a few briefs as additional functions that should be taken into account.

Food processing, transportation, wholesaling, and retailing receive scant attention, yet these elements of the agri-food system account for 90 per cent of the price consumers pay for food. The almost exclusive focus on farming could be criticized for setting the debate in too narrow a perspective. Clearly it would be desirable to discuss sustainability of the entire agri-food system. But the emphasis revealed in the submissions does perhaps reflect popular perception and exposes the methodological challenge of broadening analysis beyond any one narrowly defined economic sector.

Economic viability

Farm numbers peaked at 733 000 in 1941. Although the number of farms has decreased by 60 per cent since then and totals fewer than 300 000 today, output has increased by 175 per cent over the same period.[2]

For most respondents, economic viability refers to the viability of the producer rather than the agri-food system as a whole.

There is a fairly common assumption that economic viability is a precondition for environmental sustainability. Some briefs, however, explicitly reject this assumption, arguing that short-term competitive goals such as obtaining maximum yields are intrinsically incompatible with the long-term goal of environmental sustainability. For this reason, at least one submission would exclude all reference to economic criteria from the definition of sustainable agriculture.

A further general assumption is that achieving environmental sustainability will mean an increase in the cost of food production that will have to be absorbed somewhere in the system.

Some argue that such additional costs should be passed on to consumers as part of the price of food. Others feel this would only make things worse and that the problem must be "addressed at the source, not at the supermarket counter," to quote the brief from Macdonald College.

At the same time, a number of briefs comment that it would be unfair to expect producers to bear what should be a society-wide cost. One frequently advanced solution would be to compensate farmers for valuable functions other than food production, such as preserving wildlife habitat and serving as trustees of the environment.

Social dimensions

Although almost all the briefs view agriculture as an economic activity, making money is not necessarily perceived as the be-all and end-all of farming.

Many respondents attach great importance to the social dimensions of farming. As the Agricultural Institute of Canada notes, agriculture has been described by many farmers as "a way of life." The AIC brief adds this explanation:

> The things that make farming a way of life have to do with the social interactions within the rural community,

> the service institutions in the rural community, the "closeness" to nature that has a special place in the hearts of farmers, and the freedom farmers enjoy to make their own choices on farming and related activities.

Some briefs also convey the sense of moral responsibility implicit in farmers' view of themselves as stewards of the land and trustees of the environment, and in their belief that one of the purposes of Canadian agriculture is to help ensure enough food is produced to meet global needs.

However, moral responsibility is a two-way street. According to the Canadian Society of Agricultural Engineering, society has a responsibility to provide agriculture with a favourable political and economic environment, as well as all the necessary natural resources including clean air, adequate fertile land, and an adequate supply of fresh water. In this view what is needed is a new social contract between farmers and the public that recognizes their mutual interest in an adequate supply of good food and a healthy environment.

The safety of food and of food producers are issues raised frequently in the submissions. Discussion of food safety centres on the use or non-use of pesticides during food production although a few briefs note that processing and handling may pose greater safety threats. Discussion of the safety of producers generally focuses on the risks of storing and handling pesticides and fertilizers. Better government regulations are regarded as necessary for resolving safety concerns.

Between 1977 and 1986, there were 421 farming-related fatalities in Ontario alone. Nearly two-thirds of these fatalities involved tractors or other farm machinery.[3]

Resource management

Conservation of resources and the environment is central to the concept of sustainable agriculture. As the Canadian Society of Zoologists notes, agricultural practices should aim not to deplete resources. Non-renewable resources should be recycled, renewable resources should not be used at rates exceeding renewal, and practices should be as independent as possible of fossil fuel resources.

A "limits to growth" perspective surfaces here and there in the recognition that global resources are finite, implying a maximum beyond which the world's population cannot grow.

The need for a broad ecological perspective is stressed in a number of submissions. The Agricultural Institute of Canada, for example, points out that one method of conserving Canada's resources would be to import fossil fuels, but that the result would be a negative impact on the world environment. A regional approach to sustainability is urged by others, such as Environment Canada. No one farm can be a self-contained system:

> When we look at rural areas on a regional scale, farms and farming in general are one part of a rather more complex whole. It is the sound management at a regional level (ecosystems or watersheds) that will most effectively yield us long-term sustainability of the entire system.

There are an estimated 2000 organic farmers in Canada. Of these 1000 are certified.[4]

The need for a systems (or holistic) approach is a recurrent theme in the briefs. Supporters of organic farming stress this point and propose organic farming as meeting the definitional requirements of sustainable agriculture. Many others, while accepting the need for a holistic approach, reject this equation, either conceding that the goals of organic farming may be desirable in the very long term or disputing the underlying premise that natural is always good, synthetic always bad.

Food for thought

While agreement generally prevails on the core definition of sustainable agriculture, discussion must now focus on what we need to do to achieve this broadly accepted goal. Many issues remain unresolved.

Does economic viability, for instance, mean competitiveness and achieving economic advantage on world markets? What value are we to attach to preserving a distinct way of life in rural areas, or to stewardship of the land and the environment? How will the costs of environmental sustainability be apportioned?

What is the responsibility of society to provide the appropriate conditions for agriculture? And what is the responsibility of Canadian agriculture to the people of the world?

How can science and technology be both managed and improved to reverse ecological decline?

And finally, how can the debate be extended beyond its current narrow focus on farming to encompass sustainability of the entire agri-food system?

2. FROM PRINCIPLES TO PRACTICES

In its invitation to comment on sustainability and the agricultural industry, the Science Council asked four broad questions. The first of these was:

> How adequate are existing technologies and management practices to meet future environmental and economic needs of the agriculture-food system?

Achieving sustainability will be a major challenge for Canadian agriculture. Although the practices of the past secured success in terms of an abundant supply of good, cheap food, they may be inappropriate for sustainable development. A consensus is emerging that merely making a few adjustments to our present practices will not be enough. More radical changes may be needed to bring agriculture into closer harmony with natural environmental processes, and to provide a more favourable economic environment for farming.

Loss of prime farmland

Good farmland is the most basic agricultural resource. Yet in Canada — where less than 2.5 per cent of the total area is prime agricultural land — much of that resource has been lost to urban development. Montreal, Winnipeg, Calgary, Vancouver, St. Catharines, and Toronto are just a few of the many cities built on the best agricultural land.

On a clear day 37 per cent of Canada's best agricultural land is visible from the top of Toronto's CN Tower. Between 1966 and 1986, 58 per cent of the area lost to urban expansion in Canada — 1750 square kilometres — was prime agricultural land.[5]

Once land has been built on, it is irretrievably lost to farming. Despite regulatory efforts to halt conversion, 58 per cent of the area taken for urban expansion between 1966 and 1986 was prime agricultural land. Respondents to the Science Council are almost unanimous in condemning this as an unsustainable trend.

Land purchased by hobby farmers, however, is not lost to agriculture. Hobby farms function as a kind of land bank, saving farmland for possible future agricultural use. Agriculturalists often view hobby farmers as fringe members of their community, but a number of the briefs received by the Science Council urge government to recognize — through tax breaks, for example — the valuable role that hobby farms play in land conservation.

Conflicting land uses

Land use conversion brings with it an increased potential for conflict wherever differing uses are in close proximity. Farmers may have to contend with problems such as noises and dogs that disturb livestock, air pollution from cars, and trespassers who damage farm property and crops.

In turn, people in adjacent residential developments may not appreciate many aspects of farming — noise, dust, smells, and the use of herbicides and pesticides, for example.

The problems have led several provinces to enact right-to-farm legislation to protect farmers from litigation under nuisance laws, providing they operate within what is considered to be normal farming practice. A further strategy is zoning regulations to ensure adequate separation between conflicting land uses.

A healthy soil resource

Soil degradation is identified by producers as the single most important challenge to sustainable agriculture in Canada. As the United Grain Growers' brief says, "Without a healthy soil resource, farming can be neither profitable nor productive."

Foremost among soil problems are erosion by wind and water and compaction by heavy equipment. Other serious problems include loss of organic matter, chemical changes as soils become too acid or accumulate salts, and nutrient depletion.

Estimates of the annual on-farm cost of the losses attributed to soil degradation range from $713-1067 million. Another estimate places the annual off-farm cost of soil erosion at $125 million.[6]

In Ontario alone, the cost of soil erosion to agriculture is estimated to be in the range of $69-165 million annually. Estimates covering all forms of soil degradation in the province are as high as $545 million, according to the Ontario government. Many farmers have adopted crop rotation and other soil conservation methods, with encouragement from the National Soil Conservation Program. Some government programs, however, may inadvertently be contributing to soil degradation; the submissions recommend that this be studied as part of the federal review of national agricultural policies and programs.

Often it is hard for farmers to determine which practices are most sustainable because of the complex trade-offs involved. For example, the zero-tillage method of cultivation (planting seed directly in the stubble of last year's crop) reduces erosion but is likely to entail the use of herbicides to control weeds. Or farmers may leave crop residues standing to prevent erosion; trap moisture, and rebuild organic matter — but this may expose subsequent crops to disease and insect depredation. Close monitoring by scientists of the impact of all soil conservation techniques is recommended by respondents as a guide to public policy making.

The futility of trying to tackle problems piecemeal is noted by many respondents. Canadian Organic Growers, for example, state: "technological fixes to alleviate individual symptoms are nothing more than temporary bandaids," and emphasize that organic farmers believe that the soil must be seen as a total living system that can be kept productive by enhancing nutrient cycles, and without resorting to off-farm inputs.

Most respondents, however, stress the need to continue using agricultural chemicals, arguing that, properly applied, fertilizers and pesticides help to maintain a healthy soil and produce safe, nutritious crops in a cost-effective manner.

Water pollution

Water pollution caused by agricultural nutrients was recognized as a problem, particularly in Lake Erie, at least 30 years ago. Today, about 70 per cent of the 3000 tonnes of phosphorus that enters the Great Lakes from Canada every year comes from the synthetic fertilizers used in farming.

Groundwater pollution is a more recent concern. Wells in several parts of the country are contaminated by nitrates and other chemicals associated with agriculture.

Manure poses additional problems since it may release bacteria as well as nutrients into ground and surface water. Improved manure management practices have been adopted by many Canadian farmers under provincial government incentive programs. New practices include the use of holding tanks to store manure from dairy barns and feedlots until it can be recycled as fertilizer; and fencing off waterways so livestock do not contaminate lakes and streams while wading in to drink.

Such improvements do not come cheap. In Newfoundland, the provincial government has estimated that it will cost $16 million to correct manure management problems on the 200 farms that require it.

Water pollution by agriculture is being addressed by practices that keep the polluting elements from reaching the water: soil conservation measures to prevent erosion, advanced manure management techniques, and carefully planned fertilizer application to ensure maximum uptake of nutrients by crops. There is a general consensus in the briefs that this is the right approach, although the organic school would eliminate the use of synthetic fertilizers.

The equivalent fertilizer value of manure in Canada is estimated at $650 million annually; however, this is still less than the estimated cost involved in its collection, handling, storage, and spreading.[7]

Water conservation

Agriculture is a major user of water. According to the Inquiry on Federal Water Policy (1985), agriculture accounts for more than 87 per cent of all water consumption in the Prairies, with 90 per cent of that water being used for irrigation.

Respondents agree that sprinklers, drip systems, and other water-conserving irrigation methods should be used whenever possible, and some respondents note that the extent of irrigated land might have to be reduced if water becomes scarce.

Present practices and technology to conserve water in agriculture are seen as far from adequate. Suggested action includes designing farm and processing plant systems to minimize water use and developing techniques for recycling agricultural waste water.

Energy conservation

World agriculture is heavily supported by fossil fuels — "energy in the form of ancient sunlight," to quote the Canadian Society of Zoologists. In 35 years, these inputs have increased more than sixfold, from less than the equivalent of 0.3 billion barrels of oil in 1950 to the equivalent of nearly 1.9 billion barrels of oil in 1985. In Canada, the agri-food sector accounts for approximately 11 per cent of total energy consumption.

Making agricultural practices as independent as possible of fossil fuel resources is a widely recommended objective. The Canadian Environmental Law Association speaks of the "absolute folly of tying the long-term productivity of what should be a renewable resource, farmland, to a non-renewable resource, fossil fuels."

Reducing the energy intensity of modern agriculture would also help counter the problems of global warming, acid rain, and ozone depletion.

Organic farming is presented by some respondents as an energy-conserving option. According to Canadian Organic Growers, organic systems generally require 60 per cent less energy per unit of food produced even when the additional fuel used for weed control is taken into account.

Other energy-saving approaches include reducing tillage and the development of more fuel-efficient farm equipment. A further alternative is the use of renewable sources of energy such as wind, sunlight, flowing water, and animal waste.

A change in agricultural trading patterns could make a major contribution to energy conservation, suggests the Canadian Environmental Law Association. Under present trade patterns, commodities are transported long distances and must be processed and packaged to survive the journey. Not only are vast amounts of energy spent on processing, packaging, and transportation, but the durability of produce becomes more important than the quality.

Of the two million plant species confined to the tropical rainforests, the loss from deforestation could be as much as 6000 species a year. This is about 10 000 times greater than the naturally occurring extinction rate prior to the appearance of human beings.[8]

Plant breeding

Plant breeding technologies, including genetic engineering, have helped to develop crop varieties that produce high quality, high quantity yields, resist disease, and thrive despite drought and a short growing season. Current efforts focus on developing crop varieties with genetic resistance to viral, fungal, and bacterial pathogens.

Plant breeding has been particularly important to agriculture in Western Canada, where fungus-resistant wheat has been grown for decades. The money invested in breeding programs brings good returns. In 1989, for example, the estimated cost of the breeding program for wheat resistant to stem rust was $680 000 a year, with annual savings estimated as high as $216 million.

Plant breeding can contribute to the sustainability of agriculture by reducing the inputs required. But breeding programs rely on genetic variability and the availability of germ plasm. Agricultural history has been marked by a continual reduction in both the number of species we depend on for food and the genetic diversity within those species. Several briefs highlight the need to reverse this trend, which limits the potential of breeding programs and detracts from the long-term stability of agricultural ecosystems.

Pesticides and public concern

Nowhere is the conflict between economic, social, and environmental goals more evident than in the current debate over the use of pesticides and this is borne out in the submissions. At its heart are issues of the efficiency and profitability of agricultural operations; the demand for abundant quantities of safe, nutritious food; and the need to protect the environment from pollution.

There are no easy answers, even to the simplest questions. Will the goal of safe food, for example, be better served by using pesticides and possibly leaving residues on foods, or by avoiding pesticides and risking plant diseases that may be harmful to human health?

Risk is a compound measure describing both the likelihood of harm and its severity. The likelihood that harm will occur increases as the rate of exposure increases. To put the question of risk in perspective, the Keystone Agricultural Producers brief offers the example of chemical carcinogens. It defines unacceptable risk for these substances as that level of exposure that would lead to a risk of death from cancer greater than one in a million. This standard can be compared to other one-in-a-million risks that people are perhaps less aware of:

- 400 miles of air travel
- 60 miles of car travel
- 0.75 of a cigarette
- 20 minutes of being a man aged 60 years

This introduces the concept of "risk benefit," which is central to how we use science and technology to meet human needs. Keystone Producers emphasize this point and stress that we should measure a risk against anticipated benefit. Already governments at every level regulate and inspect food production, processing, and handling to protect consumers (and producers) from agricultural chemicals that have been documented to pose unacceptable risk.

Over 30 per cent of Canadians consider chemical pesticides and fertilizers on food crops an immediate or life-threatening risk. A further 50 per cent consider them a serious but non-life-threatening risk. About 4 per cent consider them no risk at all.[9]

The level of risk from pesticide use has been reduced through the development of new products that are targeted at specific pests and diseases, are rapidly biodegradable, and can be used in smaller quantities because of their greater efficiency. Despite the risks, most submissions support the use of pesticides. However, there is a broad consensus that their use should be restricted as part of an integrated approach to pest and disease control. Such an approach would include cultivation practices such as crop rotation; biological controls such as natural predators; and the use of plants genetically engineered to be pest and disease resistant as well as local species that are naturally resistant to local pests and diseases.

Farmers: their health and wealth

The few submissions that mention farmers' health point out that present agricultural practices put farmers' health at risk, exposing them to a work environment characterized by dust, gases, microorganisms, pesticides and other chemicals, noise, and machinery.

What is being done about these problems? One initiative is the cooperative government-industry programs to educate users of agricultural chemicals about the importance of wearing protective clothing and following proper handling and spraying procedures. However, respondents note that much more must be done to identify work-related health hazards in agriculture and to eliminate these hazards rather than merely control their effects.

Farmers' financial health is also at risk, as evidenced by the high number of farm bankruptcies. While many respondents argue that farmers ought to be able to earn a living wage for their contribution to food production, opinion is split on how best to secure this.

During the past four decades, economic pressures have led to intensive, large-scale agriculture. Across the country, thousands of small farms have been amalgamated into larger operations. High-yield

Over the last 10 years, total farm debt has exceeded the annual value of cash receipts. Over the same period, 43 000 farmers went bankrupt; more than one a day.[10]

seed stocks, larger tractors and farm implements, the dramatic yields of large monocultures in good years, and relatively low oil prices have all contributed to this trend.

The amount of capital required for modern buildings, machinery, and inputs is high, driving producers to increase their cash flow in order to service and, if they are fortunate, pay off debt. Maximum yields, lower per-unit overhead costs, and greater efficiency are the watchwords of modern industrial agriculture. Those who cannot keep ahead of the game either leave voluntarily or are forced into bankruptcy. Apart from the disruption of individual lives, this has resulted in an exodus of people from the countryside.

In wrestling with the economic and social context of modern Canadian agriculture the submissions reveal much unease and many concerns: What are the long-term prospects for Canadian agriculture and the social structure of rural Canada? Could farming on a smaller scale be economically sustainable and maintain more, viable rural communities? How will free trade affect Canadian agriculture? Will it intensify the pressure to increase production whatever the environmental consequences? Or will open competition on world markets guarantee the adaptation necessary to make Canadian agriculture economically and environmentally sustainable?

What are the options? How can economic arrangements contribute more effectively to sustainable agriculture? Should we abandon our cheap food policy in favour of a system where consumers pay the real price of food production? Can we find some way of paying farmers for services to society such as soil and water conservation, and the preservation of wetlands and wildlife shelterbelts? Exactly what does Canadian society expect of farmers?

Awareness of the interdependence of farming and broad national and international economic and social trends coexisted in many briefs with the desire for a return to a simpler world. Many respondents note that individual farmers must be allowed to make their own management decisions as they see fit. Conditions set by governments and banks are viewed as interfering with the farmer's ability to see that the right things get done at the right time with the right resource mix.

3. DESIGNED IN CANADA

Canada's agricultural success story is intimately tied to the development of plants and livestock suited to our particular conditions. Research designed in Canada is the rock on which Canadian agriculture was founded. But how will we fare in the future?

> Is our research infrastructure able to generate the types of scientific and technological innovations necessary to satisfy future requirements?

Many responses to this second question from the Science Council echo the view of Macdonald College that "Our research infrastructure is fundamentally sound but it needs some fine tuning."

At the same time respondents frequently question whether agricultural research should be expanded, with increased funding, or whether existing budgets are adequate to meet new priorities. Respondents also question the current emphasis of research funding, which appears to be encouraging short-term, compartmentalized research rather than the long-term cross-disciplinary work that is essential to sustainable agriculture.

The total annual expenditure on research and development for the Canadian agri-food sector in 1989 was $582.3 million. Almost two-thirds of this amount was provided by the federal government.[11]

A new model for research may be emerging. Several briefs note that producers are relying more on their own pooled knowledge and understanding, and research institutions are beginning to share power by inviting farmers and others to help set the research agenda.

The Canadian Phytopathological Society calls for Canadian research to meet Canadian needs. In its brief, the Society observes that research into problems peculiar to Canadian agriculture is unlikely to be a priority for other developed countries. In any case, research produced elsewhere cannot be expected to meet Canadian needs:

> In contrast with the electronics industry, we are not producing just another widget that will work equally well anywhere in the world.

Continuing commitment

Leadership both from the institutions directly involved and from other groups in Canadian society is seen by most respondents as the key ingredient in revamping agricultural research to meet the needs of the future.

We must have a new vision to guide agricultural research and the funding to realize that vision. A continuing commitment to the concept of sustainable agriculture by all sectors responsible for funding and conducting research is the starting point, suggests Soil Conservation Canada. Research priorities can then be set and financial incentives established to steer research as required.

The Canadian Society of Agricultural Engineering is confident the research infrastructure can adapt to the new environment:

> If we recall the 1970s, when the need to develop energy-conserving technologies was accepted as a challenge, public and private research created great improvements in energy utilization. Such achievements are possible again.

Research for the long term

There is widespread agreement that sustainable agriculture cannot be adequately studied by short-term, piecemeal projects. The nature of the questions demands long-term research drawing on the expertise of multidisciplinary teams and broadly grounded generalists. This position is taken, for example, in briefs from the Ontario Ministry of Food and Agriculture, the Canadian Society of Agricultural Engineering, the Canadian Phytopathological Society, the Centre for Pest Management at Simon Fraser University, and Nova Scotia Agricultural College.

Structural incompatibility

But there is a fundamental incompatibility between these goals and the current research infrastructure. As many of the submissions point out, existing funding and reward systems discourage long-term integrated studies.

University research tends to be motivated by the need to achieve publishable results in the short term (i.e., within the duration of the research grant), and researchers usually work within their own discipline. Industrial research, by the fertilizer and pesticide companies for example, exists to serve specific corporate objectives. And in the federal and provincial laboratories, where most agricultural research in Canada is carried out, downsizing has led to staff reductions and increased reliance on the private sector for contract work.

The importance of broadly focused long-term research to the development of sustainable agriculture is widely accepted. The challenge is how to restructure the funding of research to meet this objective.

More funding?

The returns to agricultural research are high and well above the rate of return expected in many other private and public investments. One estimate of the return to all agricultural research in Ontario suggests a rate of over 65 per cent.[12]

A concern expressed by such diverse respondents as the Canadian Federation of Agriculture and Ontario's Ministry of Agriculture and Food is that Canada is lagging behind other developed countries in its per capita investment in research on science and technology and that more money is needed to address emerging agricultural needs.

A number of respondents call for increased funding for research in sustainable agriculture but most admit that, in the current economic and political climate, it is unlikely that additional money will be made available. Realistically, it is a matter of making do. This recommendation from the Canadian Phytopathological Society is typical of the pragmatic approach urged by numerous briefs:

> Governments and agencies should...reorganize, reposition and redirect their existing resources (monetary and human) to appropriate programs.

Such redirection should not be at the expense of research on "conventional" production systems, however:

> In fact, it may be desirable to work toward the goal of having sustainable and conventional agriculture represent one and the same in order to avoid such a terrific conflict of interest.

A partnership approach

Cooperation between universities, governments, and the private sector is widely regarded as essential. The Macdonald College brief, for example, proposes incentives to encourage research by and collaboration with the private sector, while AGCare calls for cooperative funding arrangements between public researchers and private interests. As an example:

> Several of AGCare's member organizations currently commit funds to projects that also receive provincial, federal and university research monies to investigate cropping systems and integrated pest-control strategies.

For its part, the Canadian Federation of Agriculture supports initiatives that would encourage the private sector to invest more money in research, citing the recently enacted Plant Breeders' Rights legislation as a good example of just how this might be done.

Involvement of farmers

Greater involvement of producers in setting the research agenda is recommended by an impressive array of respondents, including Macdonald College, the Canadian Society of Agricultural Engineering, Soil Conservation Canada, AGCare, Canadian Organic Growers, and the Canadian Farm Women's Education Council. The Saskatchewan Department of Agriculture and Food stresses the need for broader participation in setting the research agenda, but leaves open the question of exactly who should be involved.

The brief from Macdonald College observes that farmers have been practically disenfranchised by most industry-government research programs because these are designed for big business. It urges that individual farmers and small groups of farmers be invited to participate in agricultural research programs. The input of local producers is particularly important in research for sustainable agriculture, since this research tends to be location specific, and the application of research findings must be tailored to meet local needs.

Greater farmer representation on research advisory boards is recommended by the AGCare brief as a way of making scientists more responsive to farmers' needs. On-farm research is an option advanced by Canadian Organic Growers. For this group, sustainable agriculture implies organic farming, with its whole-system approach. In order to understand the processes involved in organic production, observations must be made and experiments conducted in whole functioning systems on the farm, not just at experimental stations. The need for on-farm research is a logical corollary.

Focus of future research

While recognizing the contribution of past research, the submissions suggest its almost exclusive emphasis on individual crop and animal species and the reduction of food production costs is too narrow to meet the goals of sustainable agriculture. The new research agenda must focus on the interrelationships between different components in

The agro-ecosystem approach recognizes that agriculture must reflect the ecological characteristics and limits of each individual ecozone. In Canada, 90 per cent of agriculture falls within just five ecozones: Pacific maritime, boreal plain, prairie, mixed-wood plain, and Atlantic maritime.[13]

the farm system. Among specific suggestions for future research, the following are the most prominent.

Natural processes

Not enough is known about natural processes occurring in soil, water, and air. Future research should take a holistic approach, studying the full range of physical, chemical, and biological interactions within ecosystems such as the farm, the watershed, and the region. This would include the contribution of crops and livestock to the carbon and oxygen cycles and to the regeneration of soil fertility.

Over the next few decades, a rise in the global mean temperature of between 1.5°C and 4.5°C is expected. This will add to and compound existing serious problems in the global mismatch between population, consumption, and resources.[14]

More understanding of climatic change and its impact on agriculture is needed, specifically the impact on plant growth, water resources, pests, and disease.

The brief from the Natural Sciences and Engineering Research Council underlines the case for more basic research with this comment: "There is a pervasive uncertainty in current scientific knowledge of environmental causes and effects."

Soil management

Better methods are needed to monitor soil quality and to permit soil analysis by farmers. These would enable fertilizer strategies to be better adapted to variations in soils, climates, and crops. Expanded research is also needed on cropping systems and crop diversification and their impact on soil quality.

Crops and crop management

A top research priority must be the development of new seeds and planting stock adapted to Canadian conditions (such as our short growing season) and resistant to diseases. As the Canadian Phytopathological Society brief points out: "Resistance is still the most economical and environmentally 'friendly' of our disease control strategies."

Improved methods for biological control of weeds, pests, and diseases are needed, with an emphasis on integrated systems.

Biotechnology has emerged as a new technology that holds great promise for the future of agriculture. Some concern, however, is expressed by Canadian Organic Growers:

> Current research emphasizing genetic manipulation as the answer to global food problems is of grave concern to us. Little is known about the existing genetic resources of our planet or of the innumerable interactions within ecosystems. The risks of pursuing new genetic combinations, rather than looking at existing potential, are enormous.

Food and food quality

The effects of plant diseases on food quality need to be studied. For example, how harmful to human health are the chemicals found in plant blemishes? More research in agricultural engineering is recommended in order to improve food safety and quality. Better methods of

harvesting, preserving, storing, and processing should be developed to increase the value of food crops. In addition, innovative food products should be developed as a way of expanding markets for agricultural commodities.

Energy

Agriculture is a large consumer of energy in the form of gasoline and diesel oil, natural gas, and electricity. There should be research to reduce the energy used in operating farm equipment and in manufacturing farm equipment and inputs such as agricultural chemicals.

Fertilizers and pesticides account for 38 per cent of all energy consumed in farm production, followed by the operation of field machinery at 23 per cent.[13]

This point is strongly emphasized in the submission from the Canadian Society of Zoologists:

> Research is needed on the development of more energy-efficient equipment, and particularly on finding renewable (e.g. solar- and wind-based) alternatives to the fossil-fuel dependency of modern agriculture.

The zoologists' recommendation is accompanied by a warning about some of the options:

> We are uncertain about the viability of nuclear- and hydrogen-based alternatives, and recommend that careful scrutiny be given them. The nuclear alternative especially must be examined very critically from the standpoint not only of its energy efficiency but also the compatibility of nuclear waste disposal with long-term ecological considerations.

Other

Other recommendations include calls for more economic analysis of alternative agricultural practices; research on the health and safety of farmers and farm workers; and a greater emphasis on animal husbandry and its relationship to sustainable agriculture. Furthermore, agricultural products should be exploited more fully as sources of fibre, fuel, pharmaceutical, and other high-value industrial goods.

4. THE COMMON GOOD

Despite the diversity of their views on sustainable agriculture, technological requirements, and research needs, respondents generally agree on one thing: that widespread adoption of sustainable practices depends on how receptive farmers are. The Science Council's third question asked:

> Are our existing educational and extension programs adequate in terms of the transfer and application of appropriate technologies for a more sustainable agriculture/food system?

Not surprisingly, perhaps, the general assessment of education and extension as "fundamentally sound but in need of fine tuning" parallels what many of the submissions had to say about research.

Fundamental values

Respect for the environment is an ideal that has gained renewed currency throughout the world. In Canada, it draws special power from our image of this country as a land of unspoiled natural beauty. Yet it is our growing environmental consciousness that has given rise to much of the debate about sustainable agriculture in Canada.

Farmers themselves obviously support the idea of economic viability: no farm can be unprofitable for long, or it will go out of business. Long-term environmental sustainability and stewardship of the land for future generations are also strongly backed by large segments of the farm community.

From values to practice

Summer fallowing is known to promote salinization. Between 1971 and 1986, the amount of farmland used for summer fallow decreased by almost 22 per cent from 10.8 to 8.5 million hectares.[16]

What is needed to help Canadian farmers acquire the know-how to make Canadian agriculture more sustainable?

In the traditional model of agricultural extension, information originates in government or university research, or in research by agricultural supply companies. It is then conveyed to the farmer, frequently by government agricultural extension workers or by company sales representatives.

Fifteen or 20 years ago, companies supplying herbicides, pesticides, and fertilizers were partners in an industrialized agriculture aiming for maximum yields and maximum economic efficiency. But values have changed, and the emphasis has now shifted to include product safety and protection of the environment. Today, appropriate educational roles for the agri-chemical companies include training in the safe handling and use of pesticides, and advising on fertilizer application levels and tillage methods to maximize nutrient recovery and minimize harmful environmental impacts.

In Canada, university and government researchers develop most of the scientific knowledge related to agriculture. But they also have a continuing role in technology transfer. Research partnerships are one of the best ways of achieving technology transfer, suggests the Natural Sciences and Engineering Research Council in its brief, which stresses

the importance of personal contacts and working together. At the same time many respondents believe that government extension services should continue to play a lead role in keeping Canadian farmers up to date.

The funding crunch

Accompanying a general acceptance of the continued need for government extension services is the recognition that these services face severe problems. The single obstacle mentioned most often is funding. Both government agricultural extension services and the universities are experiencing cutbacks as governments trim budgets and services in an effort to reduce their deficits.

Ultimately, someone will have to pay for education and extension, and if funds are insufficient, the submissions acknowledge, hard choices will have to be made: fewer teachers or trainers, a narrower focus to their work, perhaps closing down of certain services. There is concern that, in the end, the commitment to technology transfer facilities may not be adequate to meet the needs of sustainable agriculture.

The briefs are adamant that further cuts should not be made in extension services. Rather, priorities should be rearranged so that the same or improved levels of education and extension services can be provided to support sustainable agriculture. Equally, several briefs suggest that securing sustainable agriculture does not require additional new programs; rather, they call for a reorientation of existing extension activities and educational courses. Change should be in content and philosophy rather than in structure.

It is estimated that there are approximately 1000 professionals employed in Canada to help transfer new technology and management practices to farmers. In 1982-83, the cost of providing these services was approximately $60 million.[17]

Educating extension workers

Several briefs note that continuing education for specialists working in agricultural extension services is essential and that educational programs oriented to sustainable agriculture will have to be developed.

Among the specific observations are these:

- extension workers need much closer links with both universities and growers to keep abreast of the latest scientific and technological developments as well as innovation by farmers;
- extension workers should have access to paid educational leave;
- training programs should emphasize ecological concepts;
- existing expertise in hydrology, nutrient management, waste management, and agricultural economics must be maintained and strengthened.

Taking a holistic view

There is general agreement that farmers, and indeed the public as a whole, need a broad understanding of the ecological principles upon which sustainable use of the earth must be based. This point is made, for example, by the Canadian Society of Zoologists, whose brief goes on to say:

> Only by truly understanding that nature *always* responds to what we attempt to do — in many cases in ways we traditionally have perceived as environmental backlashes to be solved by crash programs — can we begin to make our aspirations and our actions congruent with the limitations of nature and the requirements of sustainability.

Canadians spend over $5 billion each year on wildlife activities, including contributions to wildlife organizations, wildlife photography, birdfeeding, and hunting. According to a survey by the Canadian Wildlife Service, Canadians are prepared to pay a further $1 billion a year.[18]

Farmers must also recognize that they are the principal managers of large portions of Canada's rural environment, according to the brief from Environment Canada. Farmers need to be sensitized to other valued functions of the environment they manage, such as recreation, wildlife habitat, water filtration, and forestry. They should be encouraged to maintain the environment in a condition that can support these functions and should be rewarded for doing so. Environment Canada adds that the focus should not simply be sustainable agriculture, but sustainable rural systems managed holistically.

Educating farmers out of problem practices and into ecologically sound approaches is a recurring theme. The briefs indicate, for example, that farmers are now very conscious of the issue of soil conservation. The National Soil Conservation Program gets good marks from many respondents for its achievements in educating farmers about ways of maintaining a healthy soil while reducing soil degradation.

Among specific recommendations for farmer education are:

- increased post-secondary education;
- conservation education programs;
- farm management courses emphasizing sustainable approaches.

But when will farmers find the time to take such courses? This note of concern comes from the Canadian Farm Women's Network. Those planning such courses must take into account the day-to-day realities of farm families, including time constraints, off-farm employment, and lack of child care.

Farmers teaching farmers

One of the more interesting features that surfaces from a reading of the submissions is the emphasis on the self-sufficiency and resourcefulness of farmers themselves. Farmers are increasingly unwilling to listen to advice from non-farmers. A new model appears to be evolving in which farmers take over some part of the formal extension function.

Traditional agricultural extension programs can be visualized as a straight line along which information travels one way from source to farmer. The new model involves a complex communication process. Information flows in a variety of directions, in an exchange that can be initiated at any point on the network. Farmers become sources of information for each other, and in turn feed back information on their own needs to extension officials. In this way farmers themselves set the agenda for agricultural research.

To strengthen this network, the submissions recommend that:

- farm organizations and conservation groups at the farm level act as information sources to local farmers;

- farmers transfer technology to one another through field days, workshops, and town hall meetings;
- established organic farms host on-farm demonstrations;
- progressive growers, both organic and conventional, share their knowledge and experience;
- farmers practising alternative approaches to agricultural production become sources of information to extension workers;
- farmers hire their own consultants to give them advice on, for example, technology transfer;
- information technologies (computer networks and data bases) be used to aid the exchange of information.

Public education and consumer awareness

The submissions argue that the general public knows too little about farming or the issues farmers face. Producers believe that criticisms of their practices and produce are based on misconceptions and misunderstanding. They want to be recognized as professionals who produce safe and wholesome food and serve as responsible stewards of the natural resources they manage. Almost every brief submitted to the Council stresses the need for public education and consumer awareness.

Recommendations include:

- more public education about science in general:

  Food safety and environmental concerns cannot be adequately addressed if the scientific community is not trusted. (Nova Scotia Agricultural College)

- more public education on the economic and environmental impact of agriculture, and on agriculture's relative contribution to pollution:

  An educated public is better equipped to make fully informed decisions on matters pertaining to the environment and sustainable development. (Crop Protection Institute of Canada)

- an education program about food production aimed at school children and the general population:

  We must realize that 97 per cent of the population knows essentially nothing about food production. We must have an education and information program . . . so that all of the people who eat our products three times or more a day understand the issues we are facing. (Macdonald College of Agriculture)

- more consumer education about government regulatory programs and the food inspection systems now in place to safeguard public wellbeing:

  Most consumers are largely unaware of those protective programs which ensure the integrity of their food supply, or of the responsiveness of the regulatory system to address circumstances whereby the public might be subject to documented risk. (AGCare)

Legislation strictly controls the commercial use and disposal of pesticides. Households also contribute pesticides to the contaminant load in local wildlife and water. Forty-three per cent of Canadian households with yards and gardens apply pesticides.[19]

5. NEW POLICY DIRECTIONS

Sustainability is above all a public policy issue. In its final question* the Science Council asked:

> What policy changes are required to promote a system that will be both economically and environmentally sustainable?

The submissions reveal broad consensus on sustainable agriculture as a long-term goal for Canada. They also indicate agreement in principle that achieving this goal will require changes in the policy and institutional framework for Canadian agriculture. But when it comes to specific changes, opinions are widely divided.

Review of government policies

A number of provincial governments have already set out their major environmental, economic, and social objectives for food production and are now reviewing both policies and programs to see what changes need to be made.

Most people think of wheat as Canada's "cash cow." However, as a source of farm cash receipts, wheat ranks third (at 14 per cent) after cattle and dairy products.[20]

Respondents underline the need for the reviews to include assessment of the impact of government policies, many of which inadvertently encourage farmers to do things damaging to their own long-term economic wellbeing as well as to the environment. The briefs cite, for example, policies and practices that encourage grain production at the expense of stock rearing in Western Canada. More attention to the production of forages for livestock might help improve soils and diversify the economies of rural communities on the Prairies.

Needed: A policy revolution

"Policy review" is an inadequate term for the fundamental rethinking advocated by some respondents. Minor modifications of policy are unlikely to help Canada achieve sustainable agriculture, they warn. What is required is nothing less than a policy revolution.

Many briefs argue that widespread discussion of alternatives, no matter how radical they at first appear, should be encouraged. Several note that whatever policies are established must have built-in flexibility to allow testing and even adoption of novel approaches that may fall outside broadly accepted paradigms.

Respondents believe that getting a fresh perspective on policy directions will require input from all segments of society, including farmers and consumers. They point out that groups with clearly vested interests such as the agricultural supply industry, commodity-based associations, federal and provincial departments of agriculture, the financial community or even researchers themselves should not be allowed too great a say in the development of future agricultural policy.

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* Policies to address the challenge posed by sustainable agriculture flow out of the responses to all the questions posed by the Science Council. Responses to the fourth question inevitably repeat points raised in earlier chapters of this document.

Some policy principles

What characteristics are desirable in future policy? Respondents propose a series of principles that they feel should guide policy discussions. Policy must:

- integrate social, economic, agronomic, environmental, and ethical considerations;
- take a national or global view of sustainable development and avoid a narrow regional or sectoral focus;
- be informed by a sound scientific base;
- favour long-term over short-term solutions;
- recognize the need to promote the essential ecological integrity of agricultural systems;
- recognize the importance of the family farm to the social and economic life of rural Canada and aim to revitalize the rural economy;
- acknowledge that technological solutions are not possible without a concomitant shift in public attitudes and values;
- respect regional differences.

Sustaining agricultural resources

The Canadian Society of Zoologists points out that agriculture competes for resources with other human activities, and questions our ability to maintain the supply of energy and other resources such as fertilizer and water that will be required if we continue on our present course. The brief notes that both continued population growth and increased per capita consumption of resources will compound our inability to maintain current production practices.

Protecting farmland

Canada cannot afford continued loss of its best agricultural land. Respondents identify the protection of farmland as an urgent priority and urge immediate attention be given to devising land-use policies that will rationalize competing requirements.

There is general agreement that legislation should protect prime agricultural land from urban and industrial development. The goal should be to ensure sufficient agricultural land to at least meet the food needs of future generations. However, one dissenting opinion holds that there are already too many rules controlling the use of agricultural land.

The briefs recommend that marginal land currently used for agriculture should in principle revert to ecologically stabilizing non-agricultural uses and that present policies should be reviewed to ensure that they are not encouraging producers to continue farming marginal land. Policies to retire farm land are suggested as a means of diverting highly erodible or degraded areas from the production of annual crops. In addition, some respondents point out that some agricultural land is not needed for food production at present but might be needed in the future because of the changing world market and population growth. They advocate greater incentives to encourage hobby farming, since this can play a valuable role in the long-term preservation of farmland.

Almost 90 per cent of Canada's land area cannot support agriculture of any kind. Of the remaining 10 per cent, only half is free of severe physical limitations to crop production.[21]

Some respondents also identify loss of wildlife habitat as a pressing issue and recommend the purchase of habitat preservation as a service from farmers.

Runoff from agricultural land is often a major source of pollution. For example, runoff from agricultural land contributes 3000 tonnes of phosphorous and more than a million tonnes of sediment to waters in the Great Lakes' basin.[22]

Soil and water

The National Soil Conservation Program is regarded by many respondents as an effective program with appropriate policies. However, several note that much more should be done to develop better soil conservation policies.

Some argue, for example, that tax incentives and investment tax credits should be offered to encourage farmers to adopt soil conservation practices and to purchase appropriate equipment (such as no-till seeders). And agricultural subsidies could be awarded to promote soil conservation, rather than increased production. For example, farmers could be paid an end-of-season premium based on the depth of topsoil and its levels of organic matter and contaminants. Finally, it is pointed out that the federal-provincial soil and water accords should be revised to place greater emphasis on research and technology transfer.

Policy measures to safeguard water quality are also a priority for many respondents. Agriculture has been identified as a major contributor to water pollution. There is full support for a preventive approach, which would attack agricultural causes of water pollution through, for example, erosion control and careful use of fertilizers and pesticides.

Energy

Agriculture's use of fossil fuels, particularly oil and gas, is recognized as an unsustainable practice. Solutions identified include new policies to encourage use of renewable sources of energy with the aim of balancing consumption with energy renewal and reducing the threat of global warming.

For some respondents, even a switch to renewable energy would fail to attack problems at the basic structural level. For them, the broader cause of the energy crisis in agriculture is global trade. From this perspective, the solution is to meet local food demands with local supplies, thereby avoiding the massive energy costs of long-distance transport and protective packaging. Such a change would radically alter the nature of modern Canadian agriculture, which has evolved in response to international trade opportunities.

A sustainable agricultural economy

Consideration of the policy changes needed to achieve economic sustainability in agriculture inevitably reintroduces the question of what is meant by sustainability. It is clear from the submissions that a definition focusing narrowly on the profitability of the individual farm enterprise is not enough, and that policies for the longer term must address the bigger picture.

The most important factor in economic sustainability is flexibility to respond to new situations, the submissions point out. Yet much of the current debate about agriculture and sustainable agriculture

in particular is concerned with maintaining the status quo and compensating farmers to ensure their ability to compete on world markets.

As some submissions suggest, maybe we need a deeper appreciation of the role of trade and a new vision of markets as dynamic processes, in which business restructuring (bankruptcy, for example) is perceived as the working of effective mechanisms for adaptation, not as an indication of failure. For example, rather than viewing the organic movement as a threat, a dynamic and competitive industry might recognize it as a promising market opportunity.

A world without trade?

While some might argue for free global trade to encourage the flow of ideas and promote innovation, even as a means to promote effective resource allocation, several respondents fear the prospect of more open international trade. In their view, free trade threatens the economic viability of Canadian producers and could eliminate complete sectors of our present agricultural industry.

Others worry about the implications for political sovereignty. Their fear is that international trade agreements will diminish the capacity of Canada's political institutions to achieve policy objectives such as environmental protection and resource conservation. In their view national economic self-sufficiency is the answer. Each country would rely on its own resources and produce goods within its means.

The pitfalls of protectionism

Those who espouse a pro-trade philosophy say there is no guarantee that restricting the international flow of goods will bring about more efficient resource allocation, either nationally or internationally. Without free trade, they argue, countries better suited to certain kinds of production are unable to exploit their natural advantages; this condemns poor nations to continued hardship and need. Furthermore, respondents point out, experience to date suggests that without freer world trade, environmental degradation may actually get worse.

Government intervention

For many respondents, government intervention in the economy either by means of direct regulation or through subsidies and assistance programs in such areas as transportation, marketing, and income stabilization is not only desirable but essential to shift agriculture from its present unsustainable path.

According to this perspective, quotas and marketing boards are necessary for a variety of reasons: to balance food supply with demand, to control wasteful overproduction, and to extend the longevity of the nonrenewable resources upon which modern agriculture depends. However, there is a recognition that supply management systems should be reviewed both in light of the policy objectives they are intended to serve and the broader goal of sustainable development.

There is broad agreement, too, that safety net programs such as crop insurance and income stabilization are needed to protect

Many Canadians think of Canada as the bread basket of the world. With 18-20 per cent of the global market for wheat, Canada is indeed an important wheat exporter. However, it ranks sixth after China, the Soviet Union, India, the United States, and France in the quantity of wheat produced.[23]

agricultural producers against factors beyond their control and to promote a long-term management strategy. At the same time many respondents question the impact of environmental farm safety net programs such as the Gross Revenue Income Plan (GRIP) and the Net Income Stabilization Account (NISA).

A level playing field

In Europe, the Economic Community has encouraged high levels of agricultural production by guaranteeing prices and restricting imports. The U.S. meanwhile has been offering discounts to buyers, while farmers are paid their target price. The result for Canadian grain farmers has been declining market share, rock-bottom prices, and increased government assistance.

Agricultural support from the federal and provincial governments grew from $1.1 billion in 1981 to $3.8 billion in 1988 and to $3.3 billion in 1989.[24]

Policy instruments created to stabilize farm incomes in Western countries have distorted international trade. However, it is hard to deny that comparable Canadian support programs — including GRIP and NISA — are necessary to buffer Canadian farmers against low world prices. Not surprisingly, the prospect of dismantling the array of policy instruments in place in our own country without a complementary lowering of trade barriers in other countries is greeted with enormous anxiety by interest groups. Respondents agree in principle on the importance of achieving an international trade environment that is equitable to consumers and producers alike. For many, resolution of international trade disparities in agriculture is essential if sustainable agriculture is to be secured in Canada.

Agricultural science and technology

Since the 1950s, Canada has relied on agricultural technology that is resource- and capital-intensive. The labour component of Canadian agriculture has decreased to the point where food production now occupies less than 5 per cent of our working population.

Where do we go from here? The submissions reveal a growing realization that agricultural sustainability in the coming decades is going to mean "doing things smarter," and developing an increasingly knowledge-intensive approach. If this is the way of the future, policies relating to agricultural science and technology will have to be given a prominent place on the policy agenda.

Research policy

A new vision for agricultural research is emerging. It features new goals, a multidisciplinary approach, and increased participation of producers in setting the research agenda.

Improved understanding of soils, water, air, and climate will be a cornerstone of sustainable agriculture. Greater emphasis on basic science is therefore needed. Respondents also urge broadening the scope of research beyond its current focus on specific commodities and reducing production costs. More work is needed, for example, in the economics of agriculture and in new areas of applied knowledge such as biotechnology.

At the same time, respondents agree, a new research perspective must prevail, in which farming is viewed as a total system. Research must take into account the interdependence of all the components, rather than looking at them in isolation.

Long-term interdisciplinary cooperation is essential, and must be backed by adequate funding. This implies changes in funding policies, reward patterns, and administrative structures.

Opinions are divided as to whether more research money will be needed or whether it is possible to address the issue of sustainable agriculture with the current level of funding. One danger under current funding restraints, respondents warn, is that we may end up with no one doing research specifically geared to Canadian needs. If we abdicate this responsibility, we cannot expect others to do research oriented to our unique environmental conditions.

Education and extension

Provincial extension services have made a valuable contribution to Canadian agriculture over the years, but their effectiveness is now threatened by funding cuts. The briefs are adamant that we cannot afford further funding cuts in education and extension.

Changes in the content and role of extension are recommended, along with recognition of the importance of farmers as sources of information and new ideas. Public education programs are proposed to make Canadian consumers more aware of how their food is produced and of the problems faced by farmers. A more informed public will be better equipped to participate in the policy debate and to give direction to politicians.

Regulatory issues

Regulation of new technologies, particularly pesticides, is an issue raised by many of the submissions.

Some complain that the Canadian regulatory system has impeded the prompt introduction of new technologies and products. They recommend streamlining the registration process.

Others emphasize the importance of mandatory training and certification programs to ensure that handling and use of pest-control products does not harm human health or the environment. Criminal penalties for inappropriate pesticide use could also be considered.

A few briefs express concern about the potential impact of the Canada-U.S. Free Trade Agreement on Canadian health and environmental standards. The differences between the American and Canadian situations are quite real. As the Canadian Environmental Law Association points out, there are 20 per cent more active pesticide ingredients and over seven times as many pesticide products registered for use in the United States. Under the Free Trade Agreement, some respondents argue, products that do not meet the more stringent Canadian standards could be admitted for use in this country. A further concern is that free trade would diminish Canada's ability to establish and enforce health and environmental standards.

Canada is a major world food producer, with 68 million hectares of farmland. In 1988, Canada earned $21.9 billion from agricultural sales. In the same year, with less than 20 per cent of Canada's farm area, California earned $19.7 billion.[25]

Other respondents, however, think that Canada's strict regulatory policy on pesticides offers Canadian farmers an opportunity to exploit an increasingly health-conscious market. But this, of course, is conditional on upholding existing controls.

Standards-setting is a fine art, respondents recognize, in which consumer concerns have to be balanced against assessments of the relative safety of pesticides and the economic value of effective pest control to agriculture.

Two key principles for pest controls are put forward in the briefs, which would apply (as would the above observations) to technologies other than pesticides:

- more effort should be focused on alternative strategies for pest management;
- the decreased use of agricultural chemicals and the increased use of natural products or bioagents should be carefully monitored.

Implementing agricultural policy

"Use the carrot, not the stick, in implementing agricultural policy," is the recurring recommendation made in the submissions received by the Science Council.

Respondents feel strongly that farmers must be allowed to make their own management decisions in their own way, and that incentives are to be preferred to any form of compulsion. For example, producers should be encouraged to participate voluntarily in conservation initiatives, rather than obliged to participate or sacrifice access to other government programs. Similarly, incentives rather than penalties should be used to achieve compliance with stricter environmental standards.

Change for the better

About 14 per cent of Canadian workers are employed in some aspect of food production. This labour force produces over $50 billion worth of goods and services a year.[26]

No one sector of society, on its own, can accomplish the multiplicity of changes needed to make agriculture environmentally and economically sustainable in Canada. Informed, open, public debate is required to develop a vision of the kind of agriculture Canada should have in the longterm. Continued debate involving all segments of the agri-food industry will then be needed to realize this objective — to develop new policies, to direct research, and to apply research findings. There must be a willingness to change on all sides — consumers, retailers, wholesalers, input suppliers, researchers, government officials, and farmers alike. Food, after all, is everybody's business.

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ORGANIZATIONS AND PERSONS WHO MADE SUBMISSIONS

1. Department of Forestry and Agriculture, Government of Newfoundland and Labrador
2. United Grain Growers Ltd.
3. Natural Sciences and Engineering Research Council of Canada
4. The Canadian Horticultural Council
5. Canadian Environmental Law Association
6. Saskatchewan Agriculture and Food
7. Canadian Farm Women's Network
8. Canadian Society of Agricultural Engineering
9. Canadian Society of Zoologists
10. The Canadian Federation of Agriculture
11. The Canadian Phytopathological Society
12. Alberta Agriculture
13. Edward W. Manning, Chief, Sustainable Development Research, Environment Canada
14. Keystone Agricultural Producers Inc.
15. Nova Scotia Agricultural College
16. Faculty of Agriculture and Environmental Sciences, Macdonald College of McGill University
17. Marie Anne Jarochowska, professeure au département de géographie, Université du Québec à Montréal
18. Centre for Pest Management, Department of Biological Sciences, Simon Fraser University
19. Ontario Ministry of Agriculture and Food
20. Canadian Fertilizer Institute
21. The Ontario Fruit and Vegetable Growers' Association
22. Crop Protection Institute of Canada
23. Federated Women's Institutes of Canada
24. Canadian Farm Women's Education Council
25. AGCare, Agricultural Groups Concerned about Resources and the Environment
26. Canadian Organic Growers Inc.
27. Soil Conservation Canada
28. Stuart B. Hill, Associate Professor, Entomology, and Director, Ecological Agriculture Projects, Macdonald College of McGill University
29. Agricultural Institute of Canada

The Science Council of Canada is Canada's national advisory agency on science and technology policy issues. It was created in 1966 to:

- analyse science and technology policy issues;
- recommend policy directions to government;
- alert Canadians to the importance of science and technology in their lives;
- stimulate action on science and technology policy issues among governments, the private sector, and academic institutions.